

## MISCELLANEOUS.

*Notice of new Equine Mammals from the Tertiary Formation.*

By Professor O. C. MARSH.

IN this paper Prof. Marsh describes a very interesting series of remains of equine animals from the Tertiary deposits of the Western Territories, the fruit of the explorations of a party sent out by Yale College.

The American Eocene mammals of this group belong to a genus lately established by Prof. Marsh under the name of *Orohippus*; it is nearly allied to *Anchitherium*, but differs by "having four functional digits in the manus" and by the absence of the ante-orbital fossa. The dentition is very like that of *Anchitherium*, and its formula is as follows:—

Incisors  $\frac{3}{3}$ , canines  $\frac{1}{1}$ , premolars  $\frac{4}{4}$ , molars  $\frac{3}{3}$ .

There is a long diastema; and the canine is large. The known species are *Orohippus gracilis*, Marsh, *O. pumilus*, Marsh, *O. agilis*, Marsh, and *O. major*, sp. n., all from the Eocene of Wyoming and Utah. *O. major* was about the size of a fox.

A form intermediate between *Orohippus* and *Anchitherium* is described as constituting a new genus under the name of *Miohippus annectens*. It has no ante-orbital fossa; but there are only three digits in the manus. The dental formula is the same as that of *Orohippus*; and the intermediate lobes of the upper molars are more completely separated than in *Anchitherium*. *Miohippus annectens* is from the Miocene of Oregon. It was rather larger than a sheep.

*Anchitherium anceps* and *A. celer* are two new species. The former, about as large as a sheep, is from the Miocene of Oregon; the latter, a small species, about two thirds the size of *A. Bairdi*, is from the Miocene of Nebraska.

*Equus parvulus*, Marsh (Sill. Journ. xlv. p. 374), is now referred by the author to *Protohippus*, Leidy. It is from the Pliocene deposits of Nebraska; and its remains indicate an animal about  $2\frac{1}{2}$  feet in height. Another species, *Protohippus avus*, sp. n., from the Pliocene of Oregon, is represented only by teeth; but these indicate such differences from the dentition of other species that the animal will probably prove to be generically distinct.

*Pliohippus* is a new genus allied to *Equus* and having only splint bones in place of the lateral hoofs, but closely resembling *Protohippus* in its dentition, and possessing a large ante-orbital fossa. Its dental formula is as follows:—

Incisors  $\frac{3}{3}$ , canines  $\frac{1}{1}$ , premolars  $\frac{4}{4}$ , molars  $\frac{3}{3}$ .

*Pliohippus pernix*, sp. n., of which a considerable part of the skeleton has been exhumed from the Pliocene sands of the Niobrara river, Nebraska, was about the size of an ass. A second, and apparently somewhat larger species, *P. robustus*, sp. n., was obtained from the same locality.

The teeth of a new species of the supposed Miocene genus *An-*  
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*chippus*, *A. brevidens*, were obtained from Pliocene deposits in Oregon. Prof. Marsh thinks that Leidy's genera *Anchippus* and *Hyohippus* will probably prove to be identical.

Prof. Marsh concludes his paper with the following general remarks:—

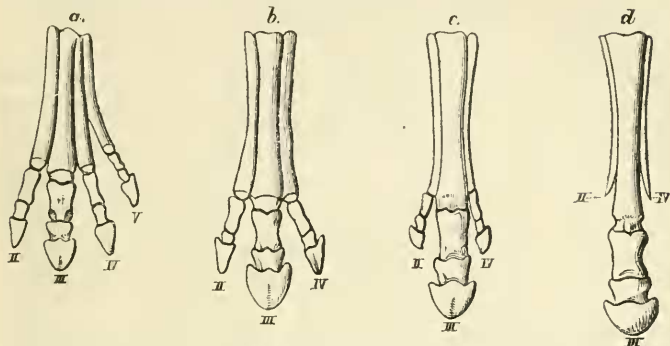
The large number of equine mammals now known from the Tertiary deposits of this country, and their regular distribution through the subdivisions of this formation, afford a good opportunity to ascertain the probable lineal descent of the modern horse. The American representative of the latter is the extinct *Equus fraternus*, Leidy, a species almost, if not entirely, identical with the Old-World *Equus caballus*, Linn., to which our recent horse belongs. Huxley has traced successfully the later genealogy of the horse through European extinct forms\*; but the line in America was probably a more direct one, and the record is more complete. Taking, then, as the extremes of a series, *Orohippus agilis*, Marsh, from the Eocene, and *Equus fraternus*, Leidy, from the Quaternary, intermediate forms may be intercalated with considerable certainty from the thirty or more well-marked species that lived in the intervening periods. The natural line of descent would seem to be through the following genera:—*Orohippus* of the Eocene; *Miohippus* and *Anchitherium* of the Miocene; *Anchippus*, *Hipparion*, *Protohippus*, and *Pliohippus* of the Pliocene; and *Equus*, Quaternary and recent.

The most marked changes undergone by the successive equine genera are as follows:—1st, increase in size; 2nd, increase in speed, through concentration of limb-bones; 3rd, elongation of head and neck, and modifications of skull. The increase in size is remarkable. The Eocene *Orohippus* was about the size of a fox; *Miohippus* and *Anchitherium*, from the Miocene, were about as large as a sheep; *Hipparion* and *Pliohippus*, of the Pliocene, equalled the ass in height; while the size of the Quaternary *Equus* was fully up to that of the modern horse.

The increase of speed was equally marked, and was a direct result of the gradual modification of the limbs. The latter were slowly concentrated, by the reduction of their lateral elements and enlargement of the axial one, until the force exerted by each limb came to act directly through its axis, in the line of motion. This concentration is well seen *e. g.* in the fore limb. There was, 1st, a change in the scapula and humerus, especially in the latter, which facilitated motion in one line only; 2nd, an expansion of the radius and reduction of the ulna, until the former alone remained entire and effective; 3rd, a shortening of all the carpal bones and enlargement of the median ones, ensuring a firmer wrist; 4th, an increase in size of the third digit, at the expense of those on each side, until the former alone supported the limb. The latter change is clearly shown in the following diagram, which represents the fore feet of four typical genera in the equine series, taken in

\* Anniversary Address, Geological Society of London, 1870.

succession from each of the geological periods in which this group of mammals is known to have lived:—



a. *Orohippus* (Eocene); b. *Miohippus* (Miocene); c. *Hipparion* (Pliocene); d. *Equus* (Quaternary).

The ancient *Orohippus* had all four digits of the manus well developed. In *Miohippus*, of the next period, the fifth toe has disappeared, or is only represented by a rudiment, and the limb is supported by the second, third, and fourth, the middle one being the largest. *Hipparion*, of the later Tertiary, still has three digits; but the third is much stouter, and the outer ones have ceased to be of use, as they do not touch the ground. In *Equus*, the last of the series, the lateral hoofs are gone, and the digits themselves are represented only by the rudimentary splint bones\*. The middle, or third, digit supports the limb; and its size has increased accordingly. The corresponding changes in the posterior limb of these genera are very similar, but not so manifest, as the oldest type (*Orohippus*) had but three toes behind. An earlier ancestor of the group, perhaps in the lowest Eocene, probably had four toes on this foot, and five in front. Such a predecessor is as clearly indicated by the feet of *Orohippus*, as the latter is by its Miocene relative. A still older ancestor, possibly in the Cretaceous, doubtless had five toes in each foot, the typical number in mammals. This reduction in the number of toes may perhaps have been due to elevation of the region inhabited, which gradually led the animals to live on higher grounds, instead of the soft lowlands where a polydactyle foot would be an advantage.

The gradual elongation of the head and neck, which took place in the successive genera of this group during the Tertiary period, was a less fundamental change than that which resulted in the reduction of the limbs. The process may be said to have already begun in *Orohippus*, if we compare that form with other most nearly allied mammals. The diastema, or "place for the bit," was well developed in both jaws even then, but increased materially

\* The modern horse occasionally has one of the ancestral hooflets developed, usually on the fore foot.

in succeeding genera. The number of the teeth remained the same until the Pliocene, when the front lower premolar was lost; and subsequently the corresponding upper tooth ceased to be functionally developed. The next upper premolar, which in *Orohippus* was the smallest of the six posterior teeth, rapidly increased in size, and soon became, as in the horse, the largest of the series. The grinding-teeth at first had very short crowns, without cement, and were inserted by distinct roots. In Pliocene species the molars became longer, and were more or less coated with cement. The modern horse has extremely long grinders, without true roots, and covered with a thick external layer of cement. The canine teeth were very large in *Orohippus*, and in this genus, as well as those from the Middle Tertiary, appear to have been well developed in both sexes. In later forms these teeth declined in size, especially as the changes in the limbs afforded other facilities for defence or escape from danger. The incisors in the early forms were small, and without the characteristic pit of the modern horse. In the genera from the American Eocene and Miocene the orbit was not enclosed behind by an entire bridge of bone; and this first makes its appearance in this country in Pliocene forms. The depression in front of the orbit so characteristic of *Auchitherium* and some of the Pliocene genera is, strange to say, not seen in *Orohippus* or the later *Miohippus*, and is wanting, likewise, in existing horses. It is an interesting fact that the peculiarly equine features acquired by *Orohippus* are retained persistently throughout the entire series of succeeding forms. Such, *e. g.*, is the form of the symphysial part of the lower jaw, and also the characteristic astragalus, with its narrow, oblique, superior ridges, and its small articular facet for the cuboid.

Such is, in brief, a general outline of the more marked changes that seem to have produced in America the highly specialized modern *Equus* from his diminutive, four-toed predecessor, the Eocene *Orohippus*. The line of descent appears to have been direct; and the remains now known supply every important intermediate form. It is, of course, impossible to say with certainty through which of the three-toed genera of the Pliocene that lived together the succession came. It is not impossible that the later species, which appear generically identical, are the descendants of more distinct Pliocene types, as the persistent tendency in all the earlier forms was in the same direction. Considering the remarkable development of the group throughout the entire Tertiary period, and its existence even later, it seems very strange that none of the species should have survived, and that we are indebted for our present horse to the Old World.

Yale College, New Haven, Feb. 20th, 1874.

*The young Asiatic Tapir* (*Rhinocærus sumatranus*).

By Dr. J. E. GRAY, F.R.S. &c.

The British Museum has had for many years a specimen of a young